Grade XI Chemistry NEB New Syllabus (2077)

Students Outcomes

Content Area: General and Physical Chemistry

1. Foundation and Fundamentals

1.1 Recognize the importance and scope of chemistry.
1.2 Explain the terms atom, molecule, radicals, valency, molecular formula, and empirical formula.
1.3 Calculate the percentage composition of constituent elements from the molecular formula.
1.4 Define and use the terms relative atomic mass, relative molecular mass, and relative formula mass.

2. Stoichiometry

2.1 Explain Dalton's atomic theory and its postulates.
2.2 State and explain laws of stoichiometry (law of conservation of mass, law of constant proportion, law of multiple proportions, law of reciprocal proportions, and law of gaseous volume).
2.3 Explain Avogadro's hypothesis and deduce some relationships among molecular mass, vapour density, volume of gas, and number of particles.
2.4 Define a mole and explain its relation with mass, volume, and number of particles.
2.5 Interpret a balanced chemical equation in terms of interacting moles, representative particles, masses, and volume of gases (at STP) and perform stoichiometric calculations.
2.6 Identify the limiting and excess reagents in a reaction and calculate the maximum amount of products produced.
2.7 Calculate theoretical yield and percentage yield from the given actual yield.
2.8 Find empirical and molecular formula from percentage composition.

3. Atomic Structure

3.1 Explain the Rutherford atomic model and its limitations.
3.2 Summarize Bohr's atomic theory and its importance.
3.3 Explain the origin of hydrogen spectra with the help of Bohr's model.
3.4 Explain the general idea about de Broglie's wave equation and probability.
3.5 Explain quantum numbers and Planck's quantum theory.
3.6 Explain the concept and general shapes of s,p,d, and f orbitals.
3.7 Use the Aufbau principle, Pauli Exclusion Principle, and Hund's rule to write the electronic configuration of the atoms and ions.

4. Classification of elements and Periodic Table

4.1 Explain the modern periodic table and its features.
4.2 Classify the elements of the periodic table in different blocks and groups.
4.3 Identify the elements as metals, non-metals, and metalloids.
4.4 Define the term nuclear charge and effective nuclear charge.
4.5 Explain and interpret the Periodic trend of atomic radii, ionic radii, ionization energy, electronegativity, electron affinity, and metallic characters of elements.

5. Chemical Bonding and Shapes of Molecules

5.1 Show the structure of atoms and ions by the Lewis dot method.
5.2 Explain the ionic bond and the properties of ionic compounds.
5.3 Explain the covalent bond, co-ordinate bond, and the properties of a covalent compound.
5.4 Describe the feature of sigma and Pi-bond
5.5 Describe the coordinate covalent compounds with some examples.
5.6 Write the Lewis dot diagrams of some ionic and covalent compounds (NaCl, MgCl2, NH4Cl, Oxides of Hydrogen, Nitrogen and Phosphorus, common mineral acids).
5.7 Write the resonance structure of some covalent species.
5.8 Explain the properties of molecular and metallic solids based on Van der Waals ' and metallic bonding.
5.9 Use VSEPR theory to describe the shapes of simple covalent molecules.
5.10 Describe the concept of hybridization in simple covalent molecules.

5.11 Explain the characteristics of a bond in terms of dipole moment, Ionic character, and bond length.
5.12 Describe the hydrogen bonding and outline the importance of hydrogen bonding to the physical properties of substances, including ice and water (for example, boiling and melting points, viscosity, surface tension, and solubility).

6. Oxidation and Reduction
6.1 Define oxidation and reduction in terms of the electronic concept.
6.2 Define oxidation number and explain the rules of assigning oxidation numbers.
6.3 Calculate oxidation numbers of elements in compounds and ions.
6.4 Explain redox processes in terms of changes in oxidation number.
6.5 Use oxidation number change to identify oxidizing and reducing agents.
6.6 Balance the given redox reaction by oxidation number change or the half-equation method.
6.7 Explain the qualitative and quantitative aspects of Faraday's laws of electrolysis.

7. States of Matter
7.1 List the postulates of kinetic molecular theory.
7.2 State and explain Gas laws, related equations, and related numerical problems.
7.3 Explain Boyle's law, Charles ' law, Avogadro's law, combined gas law, Dalton's law, Graham's law
7.4 State and use the general gas equation PV = nRT in calculations.
7.5 Explain the meaning of the universal gas constant and its significance.
7.6 Distinguish between real gas and ideal gas.
7.7 Explain qualitatively in terms of intermolecular forces and molecular size:
The conditions necessary for a gas to approach ideal behavior are:
7.8 Explain the cause of deviation of real gas from the gas laws.
7.9 Explain the physical properties of liquids like Evaporation and condensation, vapour pressure and boiling, surface tension, and viscosity in terms of intermolecular force and intermolecular space.
7.10 Describe Liquid crystals and their applications.
7.11 Explain about Liquid crystal and its application.
7.12 Differentiate between amorphous and crystalline solids.
7.13 Describe the properties of crystalline solids (anisotropy, allotropy, somorphism, polymorphism, transition temperature, habit of crystal, crystal growth).
7.14 Define unit cell, crystal lattice, efflorescence, deliquescence, hygroscopy, and water of crystallization with examples.

8. Chemical equilibrium
8.1 Explain physical and chemical equilibrium in terms of a reversible reaction.
8.2 Describe the meaning of the dynamic nature of equilibrium with an example.
8.3 Explain and deduce the law of mass action.
8.4 Write the equilibrium expression and equilibrium constant with significance.
8.5 Derive the relation between Kp and Kc.
8.6 State Le Chatelier's Principle and apply it to systems in equilibrium with changes in concentration, pressure, temperature, or the addition of a catalyst.

Content Area: Inorganic Chemistry

9. Chemistry of Non-metals
9.1 Describe and compare the chemistry of atomic and nascent hydrogen.
9.2 Explain isotopes of hydrogen and their uses, application of hydrogen as fuel, heavy water, and its applications.
9.3 Explain types of oxides (acidic, basic, neutral, amphoteric, peroxide, and mixed oxides).
9.4 Recognize applications of hydrogen peroxide.
9.5 State medical and industrial application of oxygen.
9.6 Describe the occurrence, preparation (from oxygen), structure, and test of ozone.
9.7 Describe ozone layer depletion (causes, effects, and control measures) and uses of ozone.
9.8 Give a reason for the inertness of nitrogen and active nitrogen.
9.9 Give chemical properties of ammonia [Action with $CuSO_4$ solution, water,
$FeCl_3$ solution, Conc. HCl, Mercurous nitrate paper, O_2].

9.10 Explain the applications of ammonia and explain the harmful effects of ammonia.
9.11 Write the name and formula of oxy-acids of nitrogen.
9.12 Explain the chemical properties of nitric acid [HNO_3] as an acid and oxidizing agent (action with zinc, magnesium, iron, copper, sulphur, carbon, SO_2, and H_2S).
9.13 Detect nitrate ion in the laboratory.
9.14 Explain general characteristics of halogens.
9.15 Compare the methods of preparation of halogens without a diagram and description.
9.16 Explain chemical properties of halogens [With water, alkali, ammonia, oxidizing character, bleaching action] and uses of halogens (Cl_2, Br_2, and I_2).
9.17 Explain laboratory preparation of Cl_2, Br_2 and I_2.
9.18 Show preparation of haloacids (without diagram and description) and properties (reducing strength, acidic nature, and solubility).
9.19 State the uses of haloacids (HCl, HBr, and HI).
9.20 Explain allotropes of carbon (crystalline and amorphous), including fullerenes
(structure, general properties, and uses).
9.21 State properties (reducing action, reaction with metals and nonmetals) and
uses of carbon monoxide.
9.22 Name allotropes of phosphorus.
9.23 Show preparation without diagram and description, properties (basic nature, reducing nature, action with halogens and oxygen), and uses of phosphine.
9.24 Explain allotropes of sulphur (name only) and uses of sulphur.
9.25 Prepare hydrogen sulphide using Kipp's apparatus.
9.26 Explain properties (Acidic nature, reducing nature, analytical reagent) and uses of hydrogen sulphide.
9.27 Explain properties of sulphur dioxide (acidic nature, reducing nature, oxidizing nature, and bleaching action) and its uses.
9.28 Explain sulphuric acid and its properties (acidic nature, oxidising nature, dehydrating nature) and its uses.
9.29 Write the formula of sodium thiosulfate and its uses.

10. Chemistry of Metals
10.1 Define metallurgy and its types (hydrometallurgy, pyrometallurgy, and electrometallurgy).
10.2 Define ores, gangue or matrix, flux and slag, alloy and amalgam.
10.3 Explain general principles of extraction of metals (different processes involved in metallurgy) – concentration, calcination and roasting, smelting, carbon reduction, thermite and electrochemical reduction, refining of metals (poling and electro-refining).
10.4 Give general characteristics of alkali metals.
10.5 State and explain the extraction of sodium from Down's process.
10.6 Describe properties of sodium (action with Oxygen, water, acids, nonmetals and ammonia) and uses.
10.7 Explain properties and uses of sodium hydroxide (precipitation reaction and
action with carbon monoxide).
10.8 State and explain properties and uses of sodium carbonate (action with CO_2, SO_2, water, precipitation reactions).
10.9 Give general characteristics of alkaline earth metals.
10.10 Write the molecular formula and uses of (quick lime, bleaching powder, magnesia, Plaster of Paris and Epsom salt).
10.11 Explain the solubility of hydroxides, carbonates, and sulphates of alkaline earth metals.
10.12 Explain the stability of carbonates and nitrates of alkaline earth metals.

11. Bioinorganic Chemistry
11.1 Explain bioinorganic chemistry and compare it with other branches of chemistry.
11.2 Define micro and macro nutrients with examples.
11.3 State and explain the importance of metal ions in biological systems (ions of Na, K, Mg, Ca, Fe, Cu, Zn, Ni, Co, Cr).
11.4 Elaborate ion pumps (sodium-potassium and sodium-glucose pump).
11.5 Explain metal toxicity (toxicity due to iron, arsenic, mercury, lead, and cadmium).

Content Area: Organic Chemistry

12. Basic concept of organic chemistry

12.1 Define organic chemistry and organic compounds.
12.2 State and explain the origin of organic compounds.
12.3 Describe reasons for the separate study of organic compounds.
12.4 Explain the tetra-covalency and catenation property of carbon.
12.5 Describe the classification of organic compounds.
12.6 Define functional groups and homologous series with examples.
12.7 State and explain the structural formula, contracted formula, and bond line structural formula.
12.8 Introduce preliminary idea of cracking and reforming, quality of gasoline, octane number, cetane number, and gasoline additives.

13: Fundamental principles

13.1 State the IUPAC name of the organic compounds.
13.2 Detect N, S, and halogens in organic compounds by Lassaigne's test.
13.3 Define and classify isomerism in organic compounds (structure isomerism, types of structure isomerism: chain isomerism, position isomerism, functional isomerism, metamerism, and tautomerism).
13.4 State and explain the concept of geometrical isomerism (cis & trans) & optical isomerism (d &l form).
13.5 Give preliminary idea of reaction mechanism (homolytic and heterolytic fission, electrophiles, nucleophiles, and free radicals, inductive effect: +I and –I effect, resonance effect: +R and –R effect, steric hindrance).

14. Hydrocarbons

14.1 Define and describe saturated hydrocarbons (Alkanes).
14.2 Show preparation of alkanes from haloalkanes (Reduction and Wurtz reaction), Decarboxylation, Catalytic hydrogenation of alkene and alkyne.
14.3 Explain the chemical properties of alkanes,
14.4 Define and describe unsaturated hydrocarbons (Alkenes & Alkynes).
14.5 Show preparation of alkenes by dehydration of alcohol, dehydrohalogenation, and catalytic hydrogenation of alkyne.
14.6 Explain the chemical properties of alkenes, i.e., addition reaction with HX (Markovnikov's addition and peroxide effect), H_2O, O_3, and H_2SO_4 only.
14.7 Show preparation of alkynes from carbon and hydrogen, 1,2-dibromoethane, chloroform/iodoform only.
14.8 Describe chemical properties of alkynes, i.e., addition reaction with (H2, HX, H2O), acidic nature (action with Sodium, ammoniacal $AgNO_3$, and ammonical Cu_2Cl_2).
14.9 Test unsaturation of hydrocarbons (ethene&ethyne): bromine water test and Baeyer's test.
14.10 Compare physical properties of alkane, alkene, and alkyne.
14.11 Describe Kolbe's electrolysis methods for the preparation of alkane, alkene, and alkynes. alcohols from Haloalkane, primary amines, and esters.

15. Aromatic Hydrocarbons

15.1 Define aromatic compounds and their characteristics.
15.2 State and explain Huckel's rule, Kekule structure of benzene, resonance, and isomerism.
15.3 Show the preparation of benzene from: decarboxylation of sodium benzoate, phenol, ethyne, and chlorobenzene.
15.4 Explain physical properties and chemical properties of benzene (Addition reaction: hydrogen, halogen, and ozone, Electrophilic substitution reactions: orientation of benzene derivatives (o, m & p), nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation, combustion of benzene) and uses.

Content Area: Applied Chemistry

16. Fundamentals of Applied Chemistry

16.1 Explain the chemical industry and its importance.
16.2 Explain the stages in producing in the development of a new product.
16.3 Explain the economics of production.
16.4 Explain cash flow in the production cycle.
16.5 Describe running a chemical plant.
16.6 Design a chemical plant
16.7 Describe continuous and batch processing.
16.8 Explain the environmental impact of the chemical industry.

17. Modern Chemical Manufacturers

17.1 State and show the manufacture of ammonia by Haber's process (principle and flowsheet diagram).
17.2 State and show the manufacture of nitric acid by Ostwald's process (principle and flow-sheet diagram).
17.3 State and show the manufacture of sulphuric acid by the contact process (principle and flow-sheet diagram).
17.4 State and show the manufacture of sodium hydroxide by Diaphragm Cell (principle and flow-sheet diagram).
17.5 State and show the manufacture of sodium carbonate by the ammonia soda or Solvay process

17.2 Describe Fertilizers (Chemical fertilizers, types of chemical fertilizers, production of urea with flow-sheet diagram)